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During sexual reproduction, gametes are produced by meiosis. In prophase I (first step of meiosis), programmed DNA double-strand breaks (DSB) are formed by a topoisomerase-like complex (TopoVIL, composed of SPO11 and TOPOVIBL). To accurately segregate during the first meiotic division, the homologous chromosome (homolog) must be physically connected. This connection is generated through the repair of DSBs by homologous recombination (HR), using the homolog as a template. These events occur in the context of a complex chromosome reorganization: sister chromatids are organized in loops anchored on a proteinaceous structure, the axis. The axes of the homologs align and synapse through the formation of the synaptonemal complex. In mouse, the DSB formation and repair by HR are linked to this chromosome reorganization. However, the factors that mediate and link this reorganization to HR remain poorly understood.
The SMC-condensin complexes are known to shape the metaphase/anaphase chromosomes, but their role is unclear in prophase I. Two condensin complexes (I & II) are described in mammals. We recently identified TOPOVIBL as a potential interactor of NCAPD2, a condensin I subunit, suggesting a direct control of meiotic HR by condensin I. We confirmed and characterized this interaction by different approaches. To assess the role of condensins in prophase I chromosome reorganization and HR, we generated a Ncapd2 conditional knock-out mouse (Ncapd2cKO), in which the Ncapd2 gene is ablated in meiocytes at the onset of prophase I. In addition to a defect in gametogenesis, cytological analyses of the Ncapd2cKO spermatocytes show a dysregulation of HR, with an increase in the number of RAD51 and DMC1 strand exchange protein foci as well as MLH1 crossover-specific protein foci. Altogether, our data suggest that the mammalian structural complex condensin I is implicated in the control of meiotic HR, potentially through direct interaction with the TopoVIL complex.